PICASSO-CENA

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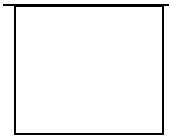

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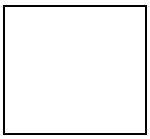

Centre **N**ational d'**E**tudes **S**patiales

Pathfinder **I**nstruments for **C**loud and **A**ero**s**ol **S**paceborne **O**bervations –
Climatologie **E**tendue des **N**uages et des **A**erosols

(PICASSO-CENA)

NASA/CNES PICASSO-CENA PROJECT
MISSION ASSURANCE MANAGEMENT PLAN

National Aeronautics and Space Administration
Langley Research Center
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Revision History Table

Revision	Date	Description
Version 1	28 Feb 01	Initial Issue

Table of Contents

1.0 Introduction

1.1 Purpose

This Mission Assurance Management Plan (MAMP) describes the Mission Assurance activities and management tools that will be utilized to ensure the quality and success of the Pathfinder Instruments for Cloud and Aerosol Spaceborne Observations-Climatologie Etendue des Nuages et des Aerosols (PICASSO-CENA) mission.

1.2 Scope

This MAMP encompasses (1) all project flight hardware from project initiation through launch operations, (2) the ground system that interfaces with flight equipment items to the extent necessary to assure the integrity and safety of flight items, and (3) all software critical for mission success. This plan is applicable to the project and its associated contractors, subcontractors, and developers.

1.3 Background

In April 1998, the Office of Earth Sciences (OES) at NASA Headquarters released the second Earth System Science Pathfinder (ESSP) Program Announcement of Opportunity (AO). The ESSP Program's intention was to initiate low cost, quick turn-around missions to accomplish high quality, focused Earth System Science measurements utilizing innovative, streamlined management and implementation approaches designed to yield high value science.

A joint proposal, from NASA and CNES was submitted in response to the AO. PICASSO-CENA had as a science objective, to collect data to better understand the role of clouds and aerosols in climate. After rigorous competition, PICASSO-CENA was selected for development in December 1998 by NASA's Earth Science Enterprise. The PICASSO-CENA mission, as part of its objective, will provide crucial measurement data on aerosol and cloud vertical structure and optical properties in a timely and cost-effective manner.

To effectively meet the objectives of missions such as PICASSO-CENA, NASA has adopted commercial practices, such as ISO 9001 Quality Management requirements for hardware and software quality assurance where they are suitable for spacecraft applications. Remaining assurance areas (reviews, validation, electronic packaging and processes, parts, materials, reliability, and contamination) are not currently covered by ISO requirements. Therefore, flight projects must tailor their requirements to satisfy mission needs. Additionally, some augmentation of ISO requirements is recommended in the quality and software assurance sections.

Also, one area of Mission Assurance that is not negotiable is the Flight System Safety Requirements. The Safety requirements are levied by the launch range and the launch vehicle provider and are mandatory compliance items for all space flight hardware developers.

1.4 Responsibility

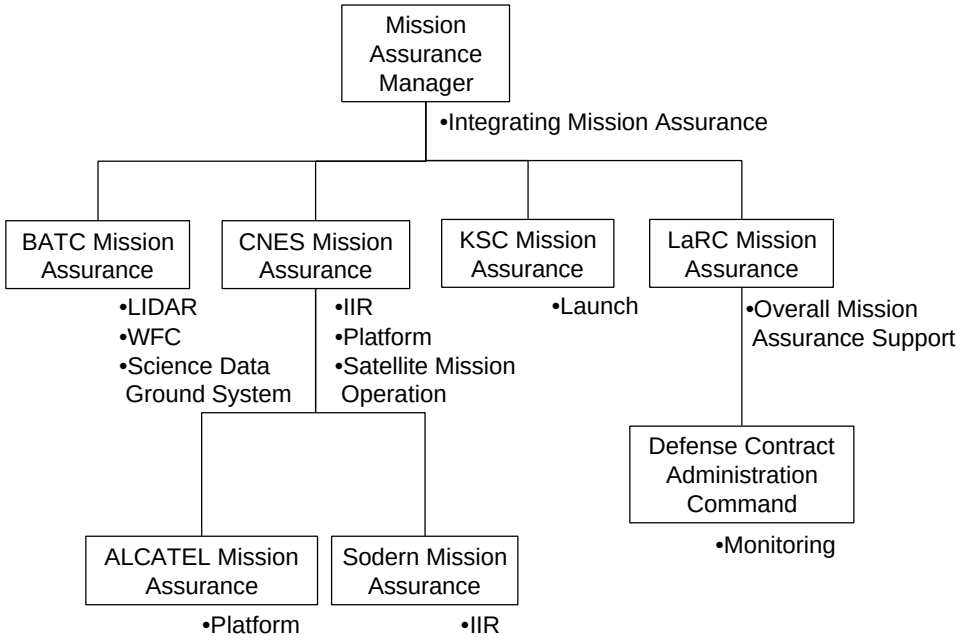
The NASA Langley Research Center Office of Mission Assurance (OMA) is designated as the primary responsible organization for overall mission assurance activities on the PICASSO-CENA Project. In order to accomplish this activity the OMA will assign a Mission Assurance Manager (MAM) who will exercise oversight of all assurance planning and activities in concert with the partners' assurance representatives. Appendix 2 lists Roles and Responsibilities of Key players in the PICASSO-CENA Project.

Managers of the assurance activities will have direct access to program management independent of project management, with the functional freedom and authority to interact with all other elements of the project. Mission Assurance issues requiring project management attention should be addressed through the MAM.

NASA and CNES manage their respective mission and/or product assurance activities according to their own standards.

1.4.1 Mission Assurance Organization

The Mission Assurance Team includes NASA Langley Research Center (LaRC), the French Centre National d'Etudes Spatiales (CNES), Ball Aerospace & Technologies Corporation (BATC), ALCATEL, Sodern and NASA Kennedy Space Center. The MAM leads the Mission Assurance organization as outlined below.



1.5 Multi-Mission Hardware / Software

Hardware or Software that was designed, developed, fabricated or flown on a previous project is considered to have demonstrated compliance with some or all of the requirements of this document such that certain tasks need not be repeated. However, the proposed or user of such hardware or software will be required to demonstrate how the hardware complies with requirements, and submit substantiating documentation to the MAM that ensures that the application of such hardware / software proposed for PICASSO-CENA was covered by previous Mission Assurance testing, and validation requirements.

2.0 Reference Documents

Because of the international aspects of this project, documents may be produced in English and French. All documents should be provided in electronic as well as printed format. Reference herein is to the English language version of the document cited.

Document No.	Document Title	Originator
PC-AGR-504	NASA/CNES PICASSO-CENA Project Plan	PICASSO-CENA Project
300-PG-7120.2.2	Mission Assurance Guidelines (MAG) for Tailoring to the Needs of GSFC Projects	GSFC
300-PG-7120.2.1	Mission Assurance Guidelines (MAG) Implementation	GSFC
300-PG-1060.1.2A	Assurance Management	GSFC
EWR-127-1	Eastern and Western Range Safety Requirements	NASA
INO110-DRD-5	Product Assurance Plan for the PICASSO-CENA Instruments, Payload and Ground Systems	BATC
INST-311	ESSP Project Mission Assurance Guidelines & Requirements	GSFC
LER 72.10427	Preliminary IIR Product Assurance Plan	SODERN
NASA 1124	Outgassing Data for Selecting Spacecraft Materials	NASA
311-INST-001	Instructions for EEE Parts Selection, Screening and Qualification	GSFC
MIL-STD-1629A	Procedures for Performing a Failure Mode, Effects and Critical Analysis	MIL-STD
S-302-89-01	Procedure for Performing a Failure Modes and Effects Analysis	GSFC
LMS-CP	Langley Management System - Procedures	LaRC

3.0 Mission Assurance Management

3.1 Quality Requirements

All organizations involved in the developing, testing, manufacturing, assembly or handling of PICASSO-CENA hardware or software will have a Management System that is in compliance to the minimum requirements of ANSI/ASQC Q9001-1994 "Quality Systems - Model for Quality Assurance in Design, Development, Production, Installation, and Servicing. In addition the Management Systems shall conform to the augmentations or enhancements contained in this document, as well as detail plans which grow from this document.

For the PICASSO-CENA Project, CNES will make use of existing Quality Managements Systems normally used for spacecraft activity such that envisioned under this project so long as such documentation meets the intent of the NASA and other government and commercial standards imposed on the project.

3.2 Mission Assurance Activities

The MAM for the PICASSO-CENA project will develop necessary procedures and processes to ensure the implementation of this MAMP. The implementation will, as a minimum, include the following activities.

- A System Safety Program that is consistent with the requirements imposed by the appropriate launch range, and launch vehicle manufacturer or launch service provider.
- A Technical Review Program.
- A Design Validation Program that includes environmental testing tailored to reflect hardware criticality, mission objectives, and the level of risk accepted by the project.
- An Electronic Packaging and Processes Program that assures that all electronic packaging techniques, processes and workmanship activities meet mission objectives and reliability.
- An Electrical, Electronic and Electromechanical (EEE) Parts Program.
- A Materials and Processes Program that assures the appropriate selection of processes, inspection and testing of materials, and lubrication.
- A Reliability Program designed to effectively interface with other program disciplines.
- A Contamination Control Program that establishes specific cleanliness requirements and approaches to be followed.
- A Continuous Risk Management Program.
- A Software quality Assurance Program.
- A Configuration Management Program.
- A Failure Reporting, Tracking and Trending Program.

All organizations involved in the developing, testing, manufacturing, assembly or handling of PICASSO-CENA hardware or software will develop either a Product Assurance Plan (PAP) describing the necessary components and the implementation of the above programs, or separate assurance documents outlining the steps to be taken for the implementation of specific programs.

3.2.1 System Safety Program

The PICASSO-CENA System Safety Program is fully described in PC-02-XX, NASA/CNES PICASSO-CENA Project Safety Plan. The PICASSO-CENA Project Safety Plan provides a

detailed description of the tasks and activities required to identify, evaluate, eliminate and control hazards, or reduce the associated risk to a level acceptable to the appropriate Range Safety organization. It is anticipated that PICASSO-CENA will be launched on a Delta Rocket from the Western Test Range. The PICASSO-CENA Project Safety Plan also provides a basis of understanding between NASA, CNES, their contractors, and Range Safety on how the safety activities are to be conducted to meet the design and operational safety requirements of EWR 127.1.

3.2.2 Technical Review Program

The primary objective of the Technical Review Program is to enhance the probability of success of the mission. This objective will be achieved throughout the PICASSO-CENA Project by bringing to bear on the project the cumulative knowledge of a team of engineers and scientists who have had extensive prior experience with the particular types of systems and functions involved. While the reviews are technically oriented, proper consideration will also be given to constraints operating on the mission.

Specific technical reviews are defined in PC-AGR-504, NASA/CNES PICASSO-CENA Project Plan. The reviews are part of the project Master Schedule that is under configuration management and is maintained by the LaRC Project Office.

It is the responsibility of the MAM to ensure that all Mission Assurance activity areas listed in Section 3.2 of this document are reported on at all scheduled and called technical reviews. In addition to the formal technical reviews the MAM, or designated Mission Assurance personnel from the individual organizations involved in the PICASSO-CENA Project, shall support engineering peer reviews to the extent possible.

3.2.3 Design Validation

A Design Validation Program will be implemented by the MAM that documents the overall validation plan and implementation. The plan will be designed to ensure that the results will meet the specified mission requirements, and provide traceability from mission specification to launch and on-orbit capability. The program will consists of functional demonstrations, analytical investigations, physical property measurements, and tests that simulate the environments encountered during handling, transportation, pre-launch, launch, and in-orbit operation. All prototype or protoflight hardware will undergo qualification to demonstrate compliance with the validation requirements of this section.

In addition, all other hardware (flight, follow-on, spare and re-flight) will undergo acceptance in accordance with the validation requirements of this program. The Validation Program will begin with functional testing of assemblies, and continue through functional and environmental testing supported by appropriate analysis, at the unit/component, subsystem/instrument, and spacecraft/payload levels. End-to-end testing of the assembly and appropriate network elements will conclude the program. As a minimum the Design Validation Program will have the following elements:

System Performance Validation Plan
Environmental Validation Plan
System Performance Validation Matrix

Environmental Test Matrix
Environmental Validation Specifications
Performance Validation Procedures
Validation Reports
Final System Performance Validation Report

3.2.4 Electronic Packaging and Processes

The MAM will develop procedures and processes designed to ensure that developers will plan and implement an Electronic Packaging and Processes Program that will assure that all electronic packaging technologies, processes, and workmanship activities will meet mission objectives for quality and reliability. Attention will be paid to the NASA preferred standards identified in the NASA technical standards program. However, alternate workmanship standards may be used when approved by the project.

New and/or advanced packaging technologies (e.g.,. MCMs, stacked memories, chip on board) that have not previously been used in space flight applications must be reviewed and approved through the Parts Control Board (PCB). Developer will provide a detailed Technology Validation Assessment Plan for each new technology that identifies the evaluations and data necessary for acceptance of the new/advanced technology. New/advanced technologies will be part of the Parts Identification List (PIL) and Project Approved Parts List (PAPL).

3.2.5 Electrical, Electronic and Electromechanical (EEE) Parts

The MAM for PICASSO-CENA will plan and implement an Electrical, Electronic, and Electromechanical (EEE) Parts Control Program to assure that all parts selected for use in flight hardware meet mission objectives for quality and reliability. A Parts Control Plan (PCP) will be prepared describing the approach and methodology for implementing the PCP. The PCP will also define the criteria for parts selection and approval.

The project will establish a PCB or a similar documented system to facilitate the management, selection, standardization, and control of parts and associated documentation for the duration of the contract. The PCB will be responsible for the review and approval of all parts for conformance to established criteria, and for developing and maintaining a PAPL. In addition, the PCB will be responsible for all parts activities such as failure investigations, disposition of non-conformances, and problem resolutions. PCB operating procedures will be included as part of the PCP.

All parts will be selected and processed in accordance with the GSFC 311-INST-001 Instructions for EEE Parts Selection, Screening and Qualification. The appropriate parts quality level defined in 311-INST-001 will be based on system redundancy or criticality as determined by the Project Manager. The requirements of 311-INST-001 are further tailored to require level 2 parts with screening and qualification of level 3.

3.2.6 Materials and Processes

The MAM shall ensure that all hardware developers implement a comprehensive Materials and Processes Plan beginning at the design stage of the hardware. The plan will be

designed to ensure the success and safety of the mission by the appropriate selection, processing, inspection, and testing of the materials and lubricants employed to meet the operational requirements for the spacecraft.
Potential problem areas such as radiation effects, thermal cycling, stress corrosion cracking, galvanic corrosion, hydrogen embrittlement, lubrication, contamination of cooled surfaces, composite materials, atomic oxygen, useful life, vacuum outgassing, toxic offgassing, flammability and fracture toughness, as well as the properties required by each material usage or application shall be addressed.

Materials that have a total mass loss <1.00% and a collected volatile condensable mass <0.10 % consistent with NASA Publication 1124, Outgassing Data for Selecting Spacecraft Materials, must be used. A single, inclusive list of all material, processes, and utilization shall be developed and maintained.

3.2.7 Reliability

The MAM will plan and implement a Reliability Program that interacts effectively with other project disciplines, including systems engineering, hardware design, and product assurance. The program will be tailored according to the risk level deemed acceptable by the PICASSO-CENA Project. As a minimum the Reliability Program will address the following.

- Redundant functions, including alternative paths and work-arounds.
- Stress levels on component parts.
- Single failure items (points), their effect on mission objectives, and possible safety degradation.
- Reliability with respect to mission design life consistent among systems, subsystems, instruments and components.
- Limited-life items and precautions to conserve useful life for on-orbit operations.
- Engineering parameters for trend analysis.
- Replacement of parts and components
- Monitoring of redundant paths.

Failure Modes and Effects Analysis will be performed early in the design process in order to identify potential problems early. The analysis will be performed in accordance with MIL-STD-1629A, Procedures for Performing a Failure Mode, Effects and Critical Analysis or GSFC Procedure S-302-89-01, Procedures for Performing a Failure Modes and Effects Analysis.

3.2.8 Contamination Control

The MAM will ensure the development, planning and implementation of a Contamination Control Program. The program will utilize a Class 100000 cleanliness requirement for the PICASSO-CENA Project. The program will include a Contamination Control Plan (CCP) either as a separate plan or as a component of the overall Performance Assurance Plan. The CCP will establish the implementation and describe the methods that will be used to measure and maintain the levels of cleanliness required during each of the various phases of the hardware's lifetime.

3.2.9 Continuous Risk Management

The MAM will ensure the implementation of a Risk Management Program as defined by NPG 7120.5A, NASA Program and Project Management Processes and Requirements. The Risk Management Program will be delineated in a separate document and will apply to all software and hardware developed for the PICASSO-CENA products. The Risk Management Plan will be closely tied to the Reliability Program.

3.2.10 Software Quality Assurance

A Software Quality Assurance Management Plan will be developed as a separate document in accordance with ANSI/ASQC Q9000-3, with augmentations required by Goddard Space Flight Center Directive 300-PG-7120.2.2 Chapter 11, Software Assurance Requirements. If any software component is identified as safety critical, the developer will conduct a software safety program on that component that complies with NSS 1740.13, Software Safety Standard.

3.2.11 Configuration Management

The MAM will ensure the development and implementation of a Configuration Management Plan (CMP) that establishes the overall configuration management activities for the PICASSO-CENA project. The CMP will be developed as a separate document and will establish policies, standards, procedures, and uniform practices for configuration management of all PICASSO hardware, software, and associated documentation and drawings.

3.2.12 Failure Reporting, Tracking and Trending

The MAM is responsible for developing the processes and procedures necessary to ensure timely reporting of all nonconformances/failures that occur throughout the project life cycle.

The MAM will develop and/or accept//approve organizational procedures, processes, and formats for use in reporting, tracking and trending of nonconformance's on the PICASSO-CENA Project in order to ensure that consistent data is available across the project. The MAM will work with Project Partners to ensure Nonconformance/Failure Reports and Software Assurance audits are performed in accordance with the concepts defined in this MAMP and supporting documents.

Reporting of failures to the PICASSO-CENA Project shall begin with the first power on application at the box, instrument, or spacecraft levels and continues through formal acceptance of the hardware. For software problems, failure reporting begins with the first test use of the software item with the hardware item.

Failures that affect mission success, or interfaces between work performed under NASA cognizance and CNES cognizance, shall be reported through the respective organizations to the MAM, who in turn will ensure that the other organizations affected receive proper and

timely notification. Failures that occur under CNES cognizance (ALCATEL and Sodern), but which do not affect mission success or interfaces, will be handled within existing CNES reporting requirements. Failures that occur under NASA cognizance (BATC), but which do not affect mission success or interfaces, will be handled under reporting procedures and processes defined by the MAM.

4.0 Ground Data Systems

The ANSI/ASQC Q9001 compliant Quality Management System will apply to ground data system software, firmware and hardware, ground support elements (simulators, etc..), key parameter and test checkout software, and any software developed under this project that is related to flight mission operations. In all cases the development effort shall provide evidence (accessible quality records) as insight to the quality of the developing software, and/or hardware. The quality records shall include any corrective actions, relating to ground system developments, recommended by QMS audits.

5.0 Surveillance

The work activities, operations, and documentation performed by developers or his suppliers for the PICASSO-CENA Project are subject to evaluation, review, audit, and inspection by the MAM, Partner mission assurance personnel, or project designated representatives from a Government Inspection Agency, or an Independent Assurance Contractor (IAC). The MAM will delegate in-plant responsibilities and authority to those agencies via a letter of delegation, or the GSFC contract with the IAC.

Developers, upon request, will provide government assurance representatives with documents, records, and equipment required to perform their assurance and safety activities. The developer will also provide the government assurance representative(s) with an acceptable work area within developer facilities.

Appendix 1: Acronyms

ANSI	American National Standards Institute
AO	Announcement of Opportunity
ASQC	American Society for Quality Control
BATC	Ball Aerospace and Technologies Corporation
CCP	Contamination Control Plan
CMP	Configuration Management Plan
CNES	Centre National d'Etudes Spatiales
DCAC	Defense Contract Administration Command
EEE	Electrical, Electronic and Electromechanical
ESSP	Earth System Science Pathfinder
EWR	Eastern and Western Range
GSFC	Goddard Space Flight Center
IAC	Independent Assurance Contractor
ISO	International Organization for Standardization
LaRC	Langley Research Center
MAG	Mission Assurance Guidelines
MAM	Mission Assurance Manager
MAMP	Mission Assurance Management Plan
NASA	National Aeronautics and Space Administration
NPG	NASA Procedure Guidelines
NSS	
OMA	Office of Mission Assurance
OSE	Office of Earth Science
PAP	Product Assurance Plan
PAPL	Project Approved Parts List
PCB	Parts Control Board
PCP	Parts Control Plan
PICASSO-CENA	Pathfinder Instruments for Clouds and Aerosol Spaceborne Observations – Climatologie Etendue des Nuages et des Aerosols
PIL	Parts Identification List

Appendix 2: Roles and Responsibilities

Organization	Role	Responsibilities
NASA LaRC	Mission Assurance Manager	• Lead PICASSO-CENA Mission Assurance activities. • Exercise oversight of all assurance planning and activities in concert with the partners' assurance representatives. • Ensure that all Mission Assurance activity areas are reported on at all scheduled and called technical reviews. • Develop necessary procedures and processes to ensure the implementation of this MAMP. • Designate technical specialists within PICASSO-CENA to execute specific tasks • Work with CNES to ensure Nonconformance / Failure Reports and Software Assurance audits are in compliance with this plan. • Monitor the satellite, launch vehicle, and ground system verification and test. • Participate in design reviews, technical interchange meetings.
NASA LaRC	Office of Mission Assurance	• Supply a Qualified Mission Assurance Manager. • Provide adequate Mission Assurance support personnel.
CNES	Mission Assurance	• Non US lead for Mission Assurance activities. • Coordinate, maintain records, and supervise

Organization	Role	Responsibilities
		Mission Assurance activities for non US components of project. • Monitor the Sodern and ALCATEL plant-site Product Assurance. • Ensure that major satellite contractors and instrument suppliers are in compliance with appropriate Mission Assurance requirements. • Participate in design reviews, technical interchange meetings.
ALCATEL	Mission Assurance	• Conduct Mission Assurance activities on the PICASSO-CENA spacecraft and ground operations, including safety- critical hardware, and ground support equipment. • Participate in design reviews, technical interchange meetings. • Assist CNES in coordination and implementation of Mission Assurance activities.
Sodern	Mission Assurance	• Conduct IIR Instrument Mission Assurance activities.
NASA KSC	Range Safety	• Provide mission assurance inputs and oversight for US instruments and associated Ground Support Equipment. • Support CNES with the range Mission Assurance activities

Organization	Role	Responsibilities
BATC	Mission Assurance	• Conduct Lidar and WFC Mission Assurance activities. • Provide instrument-to-payload integration, launch vehicle integration support, spacecraft/launch vehicle integration and launch operations Mission Assurance support. • Provide science data downlink.
Defense Contract Administration Command (DCAC)		• Monitor Payload test effort and BATC reporting and field (on-site) assessment according to OMA issued letter of delegation.
Independent Assurance Contractor (IAC)		• Assess PICASSO-CENA activities via GSFC contract as directed.

Appendix 3: PICASSO-CENA Mission Assurance Compatibility Table

Mission Assurance Element	PICASSO-CENA Applicable Plan, Document, Review or Program	NASA Applicable Plan, Document, Review or Program	CNES Applicable Plan, Document, Review or Program	BATC Applicable Plan, Document, Review or Program	SODERN Applicable Plan, Document, Review or Program	ALCATEL Applicable Plan, Document, Review or Program
System meets intent of ISO 9001	MAMP 3.1	ANSI/ASQC Q9001-1994		IN0110-DRD 5 (1.2)		
Failure Reporting: Flight Equipment	MAMP 3.2.12	LMS-CP-5507		IN0110-DRD 5 (2.5.7)		
Failure Reporting: Ground Support Equipment	MAMP 3.2.12	LMS-CP-5507		IN0110-DRD 5 (2.5.7)		
Parts Program	MAMP 3.2.5	GSFC 311-INST-001 GSFC PPL-21		IN0110-DRD 5 (2.6.1)		
Failure Analysis	MAMP 3.2.7, 3.2.9, 3.2.12			IN0110-DRD 5 (2.6.12)		
Destructive Parts Analysis Procedure	MAMP 3.2.5, Part of EEE Parts Control Program	GSFC S-311-M-70		IN0110-DRD 5 (2.6.8)		
Materials and Processes Program	MAMP 3.2.6	NASA REF PUB 1124		IN0110-DRD 5 (4.2, 4.4.3, 5.2.3)		
Reliability Program	MAMP 3.2.7	300-PG-7120.2.2		IN0110-DRD 5 (2.5)		
Failure Modes and Effects Analysis Program	MAMP 3.2.9, Part of Risk Management Program under separate document	GSFC PRO NO S-302-89-01 MIL STD-1629A		IN0110-DRD 5 (2.5.3)		
Software Development Program	MAMP 3.2.10, Part of Software Management Program (Separate Doc.)	LMS-CP-4754		IN0110-DRD 5 (2.11)		
Verification Program	MAMP 3.2.3	300-PG-7120.2.2		IN0110-DRD 5 (5.2.5)		
Contamination Control Program	MAMP 3.2.8	300-PG-7120.2.2		Separate Doc by PDR		
Printed Wiring Board Coupon Program	MAMP 3.2.5, Will be part of the Product Assurance Plan			IN0110-DRD 5 (2.3) MIL-P-55110?		

Mission Assurance Element	PICASSO-CENA Applicable Plan, Document, Review or Program	NASA Applicable Plan, Document, Review or Program	CNES Applicable Plan, Document, Review or Program	BATC Applicable Plan, Document, Review or Program	SODERN Applicable Plan, Document, Review or Program	ALCATEL Applicable Plan, Document, Review or Program
System Requirements Review	MAMP 3.2.2, PICASSO-CENA Project Plan	LMS-CP-5505		IN0110-DRD 5 (2.4)		
Preliminary Design Review	MAMP 3.2.2, PICASSO-CENA Project Plan	LMS-CP-5505		IN0110-DRD 5 (2.4)		
Mission Confirmation Review	MAMP 3.2.2, PICASSO-CENA Project Plan	LMS-CP-5505		IN0110-DRD 5 (2.4)		
Critical Design Review	MAMP 3.2.2, PICASSO-CENA Project Plan	LMS-CP-5505		IN0110-DRD 5 (2.4)		
Pre-Environmental Review	MAMP 3.2.2, PICASSO-CENA Project Plan	LMS-CP-5505		IN0110-DRD 5 (2.4)		
Mission Readiness Review	MAMP 3.2.2, PICASSO-CENA Project Plan	LMS-CP-5505		IN0110-DRD 5 (2.4)		
Launch Readiness Review	MAMP 3.2.2, PICASSO-CENA Project Plan	LMS-CP-5505		IN0110-DRD 5 (2.4)		
Soldering of Electrical Connections Standard	MAMP 3.2.4, Part of the Product Assurance Plan	NASA-STD-8739.3		IN0110-DRD 5 (5.2.3.1)		
Cabling and Harnessing Standard	MAMP 3.2.4, Part of the Product Assurance Plan	NASA-STD-8739.4 MIL-STD-1130B		IN0110-DRD 5 (5.2.3.1)		
Crimping Standard	MAMP 3.2.4, Part of the Product Assurance Plan	NASA-STD-8739.4 MIL-STD-1130B		IN0110-DRD 5 (5.2.3.1)		
Conformal Coating Standard	MAMP 3.2.4, Part of the Product Assurance Plan	NAS 5300.4 (3J-1)		IN0110-DRD 5 (5.2.3.1)		
ESD Control Standard	MAMP 3.2.4, Part of the Product Assurance Plan	NASA-STD-8739.7		IN0110-DRD 5 (5.2.3.1)		
Surface Mount Technology Standard	MAMP 3.2.4, Part of the Product Assurance Plan	NHS 5300.4 (3M)		IN0110-DRD 5 (5.2.3.1)		
Printed Wiring Board Design Standard	MAMP 3.2.4, Part of the Product Assurance Plan	ANSI/IPC-D-275		IN0110-DRD 5 (5.2.3.1)		
Printed Wiring Board Procurement Standard	MAMP 3.2.4, Part of the Product Assurance Plan	GSFC S-312-P-003B IPC 6011 IPC 6012 CLASS 3		IN0110-DRD 5 (5.2.3.1)		
Fiber Optic Standard	MAMP 3.2.4, Part of the Product Assurance Plan	NASA-STD-8739.5				

Appendix 4: PICASSO-CENA Mission Assurance Requirements Trace

Source: GSFC. Earth Probes – GSFC (EP-G) Program Mission Assurance Guidelines & Requirements, Aug 99

Implementation: LaRC. Mission Assurance Management Plan for PICASSO-CENA, [This plan]

Item	Source		Implementation		Notes
	Location	**Statement**	**Location**	**Statement**	
1.	PREFACE	Each Earth Probe – GSFC project/mission is required to be implemented in accordance with the best aerospace industry mission assurance practices, …	1., 2.	Introduction. Referenced Documents.	Indirect requirement. LMS implements an ISO compliant quality system and provides processes.
2.	1.0	The Project/Mission Team shall develop and [see next requirement]	See Item 1	See Item 1.	1st "shall". See Note 1.
3.		Implement an appropriate mission assurance program for flight hardware, software, ground support equipment and operations.	See Item 1	See Item 1.	Chained requirement. Covered by Item 6 in clearer language.
4.	2.1	The Project/Mission Team shall define and [see next requirement]	See Item 1	See item 1.	
5.		Implement a quality system based on American National Standards Institute (ANSI) / American Society for Quality Control (ASQC) 9001-1994 that meets the intent of ISO 9001.	See Item 1	See item 1.	Chained requirement.
6.	2.1	The Project/Mission Team's quality system shall encompass all flight hardware, flight software and ground support equipment development, as well as mission operations.	1.2	Scope.	Refines coverage requirement of Item 3.

Item	Source		Implementation		Notes
	Location	Statement	Location	Statement	
7.	2.2	The Project/Mission Team shall impose workmanship standards, which help assure that the required mission lifetime and performance are met. [lists 8 standards for potential use]	3.2.4	Electronic Packaging and Processes Product Assurance Plan	
8.	2.2	The Project/Mission Team and their subcontractors shall provide printed wiring board coupons to GSFC, or to a GSFC approved laboratory, for test, analysis and review.	3.2.5	Electrical, Electronic and Electromechanical (EEE) Parts Product Assurance Plan	Shipment is not an assurance function. Refer to systems engineering and contracts for action.
9.	2.3	A documented Failure Reporting System shall be implemented	3.2.12	Failure Reporting, Tracking and Trending	EP-G Program Office to approve report format. Passive requirement, PICASSO is implied implementer.
10.	3.0	The implementation of the mission shall be periodically reviewed by a competent and independent assessment team or teams, to assure that satisfactory progress is being made toward meeting mission requirements	3.2.2	Technical Review Program Project Plan	Reflexive requirement to “Independent assessment team”.
11.	3.0	The GSFC is required to assess the thoroughness, competence and independence of the total review process and [see next requirement]	--	Not executable by LaRC.	Reflexive requirement to GSFC.
12.		Shall be invited to attend all technical reviews.	3.2.2	Technical Review Program Project Plan	Chained reflexive requirement to GSFC, but PICASSO is implied as actor.

Item	Source		Implementation		Notes
	Location	Statement	Location	Statement	
13.	3.1	The six required reviews for EP-G projects/missions are …PDR, MDR, MCR, MFRR, MRR, LRR	3.2.2	Technical Review Program Project Plan	Indirect requirement. Details specified by each review type. Trivial clerical error in source.
14.	3.1	The PDR shall occur during the mission Formulation Subprocess, but after final definition of the mission science and technical requirements.	3.2.2	Technical Review Program Project Plan	Indirect requirement. Scheduling not an assurance function. Refer to Project Management for action.
15.	3.1	The mission PSR [Pre-Ship Review] shall verify that all system elements meet the requirements of the mission and [see next requirement]	3.2.2	Technical Review Program Project Plan	Project expects SMRD to be available in Feb 2000.
16.		Are ready to proceed into final launch preparations.	3.2.2	Technical Review Program Project Plan	Chained requirement.
17.	3.1	The mission PSR shall verify that testing has been completed with no unacceptable open issues and [see next requirement]	3.2.2	Technical Review Program Project Plan	
18.		To validate the readiness of the flight hardware and software and ground system.	3.2.2	Technical Review Program Project Plan	Chained requirement. Unclear, but readiness for flight is inferred.
19.	3.1	The FRR [Flight Readiness Review] shall take place at the launch site just prior to launch.	3.2.2	Technical Review Program Project Plan	Passive requirement. LaRC participation in FRR understood. Launch authority schedules, not LaRC.

Item	Source		Implementation		Notes
	Location	**Statement**	**Location**	**Statement**	
20.	3.2	Additional Mission Reviews [SRR, CDR, and PER] are recommended … and shall be conducted by independent and competent outside consultants, peers or Project/Mission Team personnel.	3.2.2	Technical Review Program Project Plan	Conditional requirement. If plan optional reviews, they must meet standards of required reviews.
21.	4.1	The Project/Mission Team shall implement a parts program that assures mission reliability and [see next requirement]	3.2.5	Electrical, Electronic, and Electromechanical (EEE) Parts Product Assurance Plan	
22.		Performance requirements are met.	3.2.5	Electrical, Electronic, and Electromechanical (EEE) Parts Product Assurance Plan	Chained requirement.
23.	4.1	A Failure Analysis shall be performed on all parts/components that fail after the final assembly of flight components and subsystems has been started.	3.2.12 3.2.7	Failure Reporting, Tracking and Trending Reliability	
24.	4.2	The Project/Mission Team shall implement a Materials and Processes program.	3.2.6	Materials and Processes.	
25.	4.3	The Project/Mission Team shall plan and [see next requirement]	3.2.7	Reliability.	
26.	4.3	Implement a reliability program that interacts with other mission disciplines including systems engineering, hardware design, parts selection, and systems safety.	3.2.7	Reliability.	Chained requirement. Identifies two technical requirements as reliability program objectives.

Item	Source		Implementation		Notes
	Location	**Statement**	**Location**	**Statement**	
27.	4.4	The Project/Mission Team shall employ a structured program for the development of software.	3.2.10	Software Quality Assurance. Software Quality Assurance Management Plan	Develop process specification is not an assurance function. Refer to project management. SQA will evaluate
28.	4.4	The [structured program for software development] shall address appropriate development life cycle phases such as: requirements analysis, design, code and unit test, integration and build test, performance verification, and maintenance.	3.2.10	Software Quality Assurance. Software Quality Assurance Management Plan	Incomplete as written. Implied chained requirement. See item 27.
29.	4.4	Code produced shall be structured, error-free, and maintainable.	3.2.10	Software Quality Assurance. Software Quality Assurance Management Plan	Software development is not an assurance function. See item 27.
30.	5.0	Each Project/Mission Team shall conduct a verification program to ensure that the flight hardware meets the mission requirements.	3.2.3	Design Validation	
31.	6.0	The Project/Mission Team shall identify contamination requirements and [see next requirement]	3.2.8	Contamination Control	
32.		Establish and maintain a contamination control program consistent with mission requirements.	3.2.8	Contamination Control	Chained requirement.